Eyes Without a Face: Integrating detached facial features into Pixar's character pipeline

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ABSTRACT

From an asset creation perspective, Pixar's first long formseries, *Win or Lose*, had a daunting number of featured characters. In addition to the large scope of the project, the design pushed further into the stylistic trend of somerecent Pixar films - favoring graphic shape language infacial expressions. The methodology that was so successful in those projects simply wouldn't scale to the number of characters we needed to deliver. In terms of articulation, we knew that one thing that made wide, round mouths difficult was maintaining smooth surfaces as the topology skewed and distorted around the nose and cheeks. That insight prompted the question: "What if they weren't connected?"

While we pursued this idea with a focus on the advantages in asset creation, when those assets were put in the hands of animators, we found that the approach yielded an unexpected quality to the animation: combining the graphic nature of 2D design in a 3D environment.

1 CONCEPT

With *Detached Facial Features* (DFF), a face consists of a blank face surface with just eyes. The ears, nose, and mouth are modeled, articulated, and shaded separately and then reintegrated into the face. This means that not only do we have the ability to turn off facial features on-the-fly in shots and have "nose-free" characters that still share our universal topology (an artistic ask on our show), we're also no longer constrained by the mouth being topologically part of the face and the volume management that comes with that. Having the features topology-independent from the face means we now can place them anywhere on the head (Figure 1).

2 RIGGING

For the nose and ears, we could simply project along the outer edges of the facial feature to the surface of the head to blend the surfaces, but the mouth was more complex. Since the mouth could be placed anywhere on the face, we needed a spacial way of reintegration

Figure 1: DFF decomposes a face into separated parts that are added onto of a blank face surface. ©Pixar.

as well as a way to see through the face surface into the mouth bag. We generated a live SDF from a simplistic geometry that was attached to the lip articulation and this signal was used both in the rigging-phase as well as getting passed into the hardware shader within Presto for animators and downstream for shading and rendering. As the mouth is posed (especially in twists), the boundary of the lip often cuts across the flow of topology of the head and the lip line is often offset or inset from the face geometry. As a consequence, we often didn't have the resolution or flow of topology where needed to make a smooth connection between the mouth and the face. Because the graphic line of the lip was of primary importance for the read, we dynamically distorted the topology of the face to better match the lips, using the SDF signal as a falloff. It was important for tracing purposes that the area of the mouth surface around the lips always sat on top of the head surface. In order to cleanly project and offset these surfaces one from the other, we needed a third surface, one with the topological flow of the mouth, but sealed closed between

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the upper and lower lip. We then applied relaxes or tweaks on this mesh to solve for lip crossover or large offsets between the meshes of the mouth and face (see inset).

3 SHADING AND RENDERING

Shading-wise, DFF is quite challenging. Pushing the facial expressions produces noticeable stretching/compression in our usual shading treatment, but separating the features through DFF (nose, mouth, ears) from the rest of the head creates discontinuities on the surface and illumination components. With DFF, the motion of the features is decoupled from its location on the head, which makes it interesting and exciting for animation while also creating a visual and technical challenge with how to make the features feel coherently connected for all possible locations and shapes. In terms of the design, we still wanted to see the parts incorporated into the face, not separate parts that slide around independently. Meaning we wanted the surface detail on the lips and areas around the lips, for example, to follow the lips, and the detail of the face to stay with the face, but we also wanted to see the areas connecting the lips and the face to look coherent to both surface and not deform, move or slide in disruptive ways. The style of the show supported DFF in the sense that the shapes were large and chunky and visual interest was achieved primarily from color and larger shapes and avoiding high frequency detail.

The shading technique we created involved tracing from the parts onto the head to borrow the head's manifold and illumination and creating a wide area of soft blending between the head's and the part's own manifold and illumination. The harsh boundary line created by the part was thus softened by the wide blending region.

The location of the mouth opening was no longer static with DFF but instead followed the location of the mouth. Shading created the opening on the head with model attributes passed in by rigging and managed the illumination artifacts produced by the open mesh, the intersecting geometries and the discontinuous normals. As the show progressed and animation pushed the expressions more, we also learned more about the design choices better suited for each character's expression range (Figure 2).

Figure 2: Our DFF representation enables a broad range of facial expressions. ©Pixar.

4 FUTURE WORK

While this approach gave us a lot of flexibility and freedom in posing and character creation, we'd like to develop the technique further and hone in on how we might utilize the separate mouth more fully and perhaps create a more universal mouth that can be used across the cast of characters without much individual rigging customization. We would also like to create dynamic signals for shading that adapt better for when the system has been pushed past its limits and improve the interactions with face-lines. For our show the treatment of the inner mouth was stylized and fairly dark which allowed us to forgo some illumination challenges. In the future, we would like to tackle the illumination inside the mouth when the design is not as stylized as it was on *Win or Lose*.

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